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| EXAMINER | |
|---|---|
| UMEZ ERONINI, LYNETTE T | |

| ART UNIT | PAPER NUMBER |
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Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. 09/844,352 | Applicant(s) KUMAR ET AL. |
|---|---|---|
| | Examiner Lynette T. Umez-Eronini | Art Unit 1765 |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *27 April 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *2* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

## DETAILED ACTION

### *Claim Rejections - 35 USC § 102*

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-9 are rejected under 35 U.S.C. 102(b) as being anticipated by Nulman (US 5,236,868).

Nulman teaches, " . . . a single wafer or a group of wafers on a tray is admitted into central chamber **20** of vacuum apparatus **10** through load lock **24**. A wafer may then be optionally transferred to degassing chamber **60** where any gases, including oxygen-bearing gases, will be removed. Such a degassing step would be carried out for from about 10 to 180 seconds at a temperature of from about 50°C to about 300°C in a degassing chamber maintained at a vacuum of from about $10^{-5}$ to about $10^{-9}$ Torr (column 6, lines 13-22). Applicant has described, "the environment within the transfer chamber 24 and the processing chambers constitute the clean environment. The environment with the load chamber 12 may also be included within the clean environment, in certain embodiments" (Specification, page 5 of 16, lines 25-28). Since Nulman uses the same method of transferring a wafer through a load lock **24** and degassing the wafer under the same conditions of pressure and temperature as in the claimed invention, then using the Nulman's method as described above, reads on,

A method of processing a substrate, comprising the steps of:

transferring the substrate from an ambient environment into a clean environment;

heating the substrate to at least a first temperature within the clean environment; and maintaining the substrate at no less than the first temperature within the clean environment.

Nulman also teaches, "After the wafer has been cleaned, it is transferred out of cleaning chamber **30** back to central chamber **20** and then into deposition chamber **40** where a layer of titanium, . . . is conventionally deposited onto the wafer surface using, for example, a PVD sputtering process" (column 6, lines 48-55). "After deposition of the titanium layer onto the wafer, the wafer is removed from deposition chamber **40** and, in accordance with the invention, directly transferred to annealing chamber **50** through vacuum chamber **20** . . ." (column 6, lines 62-38), read on,

selectively transferring the substrate within the clean environment to more than one processing chambers; and

processing the substrate in the more than one processing chambers.

Nulman's prior art teaches "the conventional cleaning was usually carried out in a vacuum chamber using an inert gas . . . , after which the cleaned wafer was usually transported through the ambient atmosphere to the deposition chamber" (column 2, lines 4-9), which reads on transferring the substrate from the clean environment into the ambient environment, **in claim 1**.

Nulman further teaches, "A wafer may then be optionally transferred to degassing chamber **60** . . . at a temperature of from about 50°C to about 300°C . . ."

(column 6, lines 16-22). "The cleaning chamber is maintained at a temperature within a range of from about 27°C to about 200°C during the cleaning step which is carried out for a period of from about 1 to about 500 seconds" (column 6, lines 39-43) and " . . . the process of the invention includes the transfer of the semiconductor wafer, under vacuum . . . , from a titanium deposition chamber and to an annealing chamber . . . , which permits formation to titanium nitride within the recited temperatures ranges" (column 4, lines 13-21 and lines 47-58). Hence, the aforementioned reads on,

wherein the step of maintaining the substrate at no less than the first temperature within the clean environment comprises heating all of the clean environment to at least the first temperature, **in claim 2**; and

maintaining the temperature of the substrate at no less than the first temperature within the clean environment comprises transferring and processing the substrate, **in claim 3**. Since Nulman uses the same steps of maintaining the substrate at no less than the first temperature within the clean environment, then using Nulman's steps in the same manner as the claimed invention would result in transferring and processing the substrate quickly through the more than one processing chambers within the clean environment so that the substrate does not have time to cool below the first temperature, as in **claim 3**.

The above aforementioned also reads on,

maintaining the temperature of the substrate at no less than the first temperature within the clean environment comprises heating the substrate to at least the first temperature within each of the more than one processing chambers and transferring the

substrate, **in claim 4**. Since Nulman uses the same steps of maintaining the substrate at no less than the first temperature within the clean environment, heating the substrate to at least the first temperature within each of the more than one processing chambers, and transferring the substrate in the claimed invention, then using Nulman's steps in the same manner as the claimed invention would result in transferring the substrate quickly between the more than one processing chambers within the clean environment so that the substrate does not have time to cool below the first temperature between the more than one processing chambers, **in claim 4**.

Nulman teaches, "A wafer may then be optionally transferred to degassing chamber **60** . . . at a temperature of from about 50°C to about 300°C . . ." (column 6, lines 16-22), which reads on,

wherein the first temperature is at least about 150 degrees centigrade, **in claim 5** and

encompasses a temperature of not more than about 350 degrees centigrade, **in claim 6.**

Nulman teaches, "a . . . degassing chamber maintained at a vacuum of from about $10^{-5}$ to about $10^{-9}$ Torr" (column 6, lines 18-22), which encompasses and reads on the step of reducing a pressure within the clean environment to a base pressure of between about $10^{-7}$ to about $10^{-9}$ torr, **in claim 7**.

Nulman teaches, "The wafer may be cleaned using a conventional inert gas RF etch, . . . while maintaining a vacuum of from about 1 to about 50 milliTorr in cleaning

chamber **30** . . ." (column 6, lines 28-39) and "During the annealing step, one or more nitrogen-bearing gases are flowed into annealing chamber **50** . . . while maintaining the pressure in said annealing chamber within a range of from about 100 milliTorr to about 800 Torr" (column 7, lines 41-46), which reads on,

wherein the step of processing the substrate in the more than one processing chambers further comprises selectively adjusting a pressure within the more than one processing chambers while processing the substrate in the more than one processing chambers, **in claim 8**.

Nulman's method reads on, wherein the step of process the substrate in the more than one processing chambers further comprises:

heating the substrate under a vacuum in a degassing chamber (column 6, lines 13-22),

etching the substrate in an etch chamber (column 6, lines 28-29), and

depositing a layer onto the substrate in a deposition chamber (column 6, lines 55), **in claim 9**.

### *Claim Rejections - 35 USC § 103*

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nulman (US '868) as applied to claim 1 above, and further in view of Guo et al. (US 6,077,781).

Nulman teaches, wherein the step of processing the substrate in the more than one processing chambers further comprises"

heating the substrate under a vacuum in a degassing chamber (column 6, lines 13-22),

etching the substrate in an etch chamber (column 6, lines 28-29), and

depositing a layer of titanium in a first deposition chamber (column 6, lines 48-53).

Nulman differs in failing to teach depositing a layer of titanium nitride in a second deposition chamber.

Guo teaches, " . . . the substrate first receives deposition of a collimated Ti layer, the substrate is then typically processed in the CVD TiN chamber **84**" (column 7, lines 19-21). Guo also teaches, "A second robot **78** is located in transfer chamber **80** to

transfer substrates to and from the . . . coherent Ti chamber (same as Ti deposition chamber) **82**, CVD TiN chamber **84**, . . . (column 6, lines 46-50). The above reads on depositing a layer of TiN in a second deposition chamber.

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Nulman by using Guo's method of depositing a layer of TiN in a second deposition chamber for the purpose providing an electrically conducting nucleation layer over select portions of the substrate and selectively depositing a metal film by chemical vapor deposition on the nucleation layer (Guo, column 3, lines 37-40).

***Claim Rejections - 35 USC § 102***

6. Claims 11-14 are rejected under 35 U.S.C. 102(b) as being anticipated by Nulman (US '868).

As pertaining to claim 11, Nulman teaches, " . . . a single wafer or a group of wafers on a tray is admitted into central chamber **20** of vacuum apparatus **10** through load lock **24**. A wafer may then be optionally transferred to degassing chamber **60** where any gases, including oxygen-bearing gases, will be removed. Such a degassing step would be carried out for from about 10 to 180 seconds at a temperature of from about 50°C to about 300°C in a degassing chamber maintained at a vacuum of from about $10^{-5}$ to about $10^{-9}$ Torr (column 6, lines 13-22). Applicant has described, "the environment within the transfer chamber 24 and the processing chambers constitute the clean environment. The environment with the load chamber 12 may also be

included within the clean environment, in certain embodiments" (Specification, page 5 of 16, lines 25-28). Since Nulman uses the same method of transferring a wafer through a load lock **24** and degassing the wafer under the same conditions of pressure and temperature as in the claimed invention, the using the Nulman's method as described above, reads on,

A method of processing a substrate, comprising the steps of:

transferring the substrate from an ambient environment into a clean environment; and

heating the substrate to at least a first temperature within the clean environment. Since Nulman uses the same method of transferring a wafer through a load lock **24** and degassing the wafer under the same temperature as in the claimed invention, then using the Nulman's method as described above, would result in maintaining the substrate at no less than the first temperature within the clean environment by heating all of the clean environment to at least the first temperature.

Nulman teaches, "After the wafer has been cleaned, it is transferred out of cleaning chamber **30** back to central chamber **20** and then into deposition chamber **40** where a layer of titanium, . . . is conventionally deposited onto the wafer surface using, for example, a PVD sputtering process" (column 6, lines 48-55). "After deposition of the titanium layer onto the wafer, the wafer is removed from deposition chamber **40** and, in accordance with the invention, directly transferred to annealing chamber **50** through vacuum chamber **20** . . ." (column 6, lines 62-38), which reads on,

selectively transferring the substrate within the clean environment to more than one processing chambers; and

processing the substrate in the more than one processing chambers.

Nulman's prior art teaches "the conventional cleaning was usually carried out in a vacuum chamber using an inert gas . . . , after which the cleaned wafer was usually transported through the ambient atmosphere to the deposition chamber" (column 2, lines 4-9), which reads on,

transferring the substrate from the clean environment into the ambient environment, in claim **11**.

Nulman's method of optionally transferring a wafer to degassing chamber **60** where any gases, including oxygen-bearing gases, will be removed at a temperature of from about 50°C to about 300°C in a degassing chamber maintained at a vacuum of from about $10^{-5}$ to about $10^{-9}$ Torr (column 6, lines 13-22) reads on and encompasses,

wherein the first temperature is at least about 150 centigrade and about 350 centigrade, **in claim 12**; and

the step of reducing a pressure within the clean environment to a base pressure of between about $10^{-7}$ to about $10^{-9}$ torr, **in claim 13**.

Nulman's method further reads on, wherein the step of processing the substrate in the more than one processing chambers further comprises:

heating the substrate under a vacuum in a degassing chamber (column 6, lines 13-22),

etching the substrate in an etch chamber (column 6, lines 28-29), and

depositing a layer onto the substrate in a deposition chamber (column 6, lines 55), **in claim 14**.

***Claim Rejections - 35 USC § 103***

7. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nulman (US '868) as applied to claim 11 above, and further in view of Guo (US '781).

Nulman differs in failing to teach depositing a layer of titanium nitride in a second deposition chamber.

Guo teaches, " . . . the substrate first receives deposition of a collimated Ti layer, the substrate is then typically processed in the CVD TiN chamber **84**" (column 7, lines 19-21). Guo also teaches, "A second robot **78** is located in transfer chamber 80 to transfer substrates to and from the . . .coherent Ti chamber (same as Ti deposition chamber) 82, CVD TiN chamber **84**, . . . (column 6, lines 46-50). The above reads on depositing a layer of TiN in a second deposition chamber.

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Nulman by using Guo's method of depositing a layer of TiN in a second deposition chamber for the purpose providing an electrically conducting nucleation layer over select portions of the

substrate and selectively depositing a metal film by chemical vapor deposition on the nucleation layer (Guo, column 3, lines 37-40).

***Claim Rejections - 35 USC § 102***

8. Claims 16-19 are rejected under 35 U.S.C. 102(b) as being anticipated by Nulman (US '868).

As pertaining to claim 16, Nulman teaches, " . . . a single wafer or a group of wafers on a tray is admitted into central chamber **20** of vacuum apparatus **10** through load lock **24**. A wafer may then be optionally transferred to degassing chamber **60** where any gases, including oxygen-bearing gases, will be removed. Such a degassing step would be carried out for from about 10 to 180 seconds at a temperature of from about 50°C to about 300°C in a degassing chamber maintained at a vacuum of from about $10^{-5}$ to about $10^{-9}$ Torr (column 6, lines 13-22). Applicant has described, "the environment within the transfer chamber 24 and the processing chambers constitute the clean environment. The environment with the load chamber 12 may also be included within the clean environment, in certain embodiments" (Specification, page 5 of 16, lines 25-28). Since Nulman uses the same method of transferring a wafer through a load lock **24** and degassing the wafer under the same conditions of pressure and temperature as in the claimed invention, the using the Nulman's method as described above, reads on,

A method of processing a substrate, comprising the steps of:

transferring the substrate from an ambient environment into a clean environment; and heating the substrate to at least a first temperature within the clean environment.

Nulman teaches, "After the wafer has been cleaned, it is transferred out of cleaning chamber **30** back to central chamber **20** and then into deposition chamber **40** where a layer of titanium . . . is conventionally deposited onto the wafer surface using, for example, a PVD sputtering process" (column 6, lines 48-55). "After deposition of the titanium layer onto the wafer, the wafer is removed from deposition chamber **40** and, in accordance with the invention, directly transferred to annealing chamber **50** through vacuum chamber **20** . . ." (column 6, lines 62-38). The above reads on,

selectively transferring the substrate within the clean environment to more than one processing chambers; and

processing the substrate in the more than one processing chambers.

Nulman teaches, "A wafer may then be optionally transferred to degassing chamber **60** where any gases, including oxygen-bearing gases, will be removed. Such a degassing step would be carried out . . . at a temperature of from about 50°C to about 300°C in a degassing chamber maintained at a vacuum of from about $10^{-5}$ to about $10^{-9}$ Torr (column 6, lines 13-22). Applicant has described, "the environment within the transfer chamber 24 and the processing chambers constitute the clean environment. The environment with the load chamber 12 may also be included within the clean environment, in certain embodiments" (Specification, page 5 of 16, lines 25-28). Since Nulman uses the same method of transferring a wafer through a load lock **24** and degassing the wafer under the same conditions of pressure and temperature as

in the claimed invention, then using the Nulman's method in the same manner as the claimed invention, reads on,

maintaining the substrate at no less than the first temperature within the clean environment and would result in transferring and processing the substrate quickly through the more than one processing chambers within the clean environment so that the substrate does not have time to cool below the first temperature.

Nulman's prior art teaches "the conventional cleaning was usually carried out in a vacuum chamber using an inert gas . . . , after which the cleaned wafer was usually transported through the ambient atmosphere to the deposition chamber" (column 2, lines 4-9), which reads on,

transferring the substrate from the clean environment into the ambient environment, in claim **16**.

Nulman's method of optionally transferring a wafer to degassing chamber **60** where any gases, including oxygen-bearing gases, will be removed at a temperature of from about 50°C to about 300°C in a degassing chamber maintained at a vacuum of from about $10^{-5}$ to about $10^{-9}$ Torr (column 6, lines 13-22) reads on and encompasses,

wherein the first temperature is at least about 150 centigrade and about 350 centigrade, **in claim 17**; and

the step of reducing a pressure within the clean environment to a base pressure of between about $10^{-7}$ to about $10^{-9}$ torr, **in claim 18**.

Nulman further teaches, "The wafer may be cleaned using a conventional inert gas RF etch, . . . while maintaining a vacuum of from about 1 to about 50 milliTorr in cleaning chamber **30** . . ." (column 6, lines 28-39) and "During the annealing step, one or more nitrogen-bearing gases are flowed into annealing chamber **50** . . . while maintaining the pressure in said annealing chamber within a range of from about 100 milliTorr to about 800 Torr" (column 7, lines 41-46), which reads on,

wherein the step of processing the substrate in the more than one processing chambers further comprises selectively adjusting a pressure with the more than one processing chambers while processing the substrate in the more than one processing chambers, **in claim 19**.

***Claim Rejections - 35 USC § 103***

9. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nulman (US '868) as applied to claim 16 above, and further in view of Guo (US '781).

Nulman differs in failing to teach depositing a layer of titanium nitride in a second deposition chamber.

Guo teaches, " . . . the substrate first receives deposition of a collimated Ti layer, the substrate is then typically processed in the CVD TiN chamber **84**" (column 7, lines 19-21). Guo also teaches, "A second robot **78** is located in transfer chamber **80** to transfer substrates to and from the . . .coherent Ti chamber (same as Ti deposition chamber) 82, CVD TiN chamber **84**, . . . (column 6, lines 46-50). The above reads on depositing a layer of TiN in a second deposition chamber.

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Nulman by using Guo's method of depositing a layer of TiN in a second deposition chamber for the purpose providing an electrically conducting nucleation layer over select portions of the substrate and selectively depositing a metal film by chemical vapor deposition on the nucleation layer (Guo, column 3, lines 37-40).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 703-306-9074. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 703-305-2667. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Lynette T. Umez Eronini
ltue

October 31, 2003